CLAIMS

Having thus described our invention in detail, what we claim as new and desire to secure by the Letters Patent is:

1. A method of producing a high-quality, substantially metastable SiGe-on-insulator substrate material comprising the steps of:

forming a Ge-containing layer on a surface of a top Si-containing layer having a thickness of about 500 Å or less and being located on a barrier layer that is resistant to Ge diffusion; and

heating said layers at a temperature which permits interdiffusion of Ge throughout said top Si-containing layer and said Ge-containing layer thereby forming a substantially metastable, SiGe layer atop that is resistant to relaxation on said barrier layer.

2. The method of Claim 1 wherein said top Si-containing layer and said barrier layer are components of a silicon-on-insulator (SOI) substrate.

3. The method of Claim 1 wherein said top Si-containing layer is a single crystal layer.

4. The method of Claim 1 wherein said top Si-containing layer has a thickness of from about 10 to about 350 Å.

5. The method of Claim 1 wherein said barrier layer is a patterned barrier layer.

6. The method of Claim 1 wherein said barrier layer is an unpatterned barrier layer.

7. The method of Claim 1 wherein said barrier layer comprises crystalline or non-crystalline oxides, or crystalline or non-crystalline nitrides.

8. The method of Claim 1 wherein said barrier layer is a buried oxide region that is patterned or unpatterned.

9. The method of Claim 1 wherein the Ge-containing layer comprises pure Ge or a SiGe alloy comprising up to 99.99 atomic percent Ge.

10. The method of Claim 9 wherein said Ge-containing layer is a SiGe alloy layer comprising from about 10 to about 35 atomic percent Ge.

11. The method of Claim 1 wherein said Ge-containing layer is formed by an epitaxial growth process selected from the group consisting of low-pressure chemical vapor deposition, atmospheric pressure chemical vapor deposition, ultra-high vacuum chemical vapor deposition, molecular beam epitaxy, and plasma-enhanced chemical vapor deposition.

12. The method of Claim 1 further comprising forming a Si cap layer atop said Ge-containing layer prior to performing the heating step.

13. The method of Claim 12 wherein said Si cap layer comprises epi-Si, a:Si, single or polycrystalline Si or any combination and multilayer thereof.

14. The method of Claim 1 wherein a surface oxide layer forms during said heating step.

15. The method of Claim 1 wherein said heating step is carried out in an oxidizing ambient which comprises at least one oxygen-containing gas.

16. The method of Claim 15 wherein said at least one oxygen-containing gas comprises O_2, NO, N_2O, ozone, air or mixtures thereof.

17. The method of Claim 15 further comprising an inert gas, said inert gas being employed to dilute said at least one oxygen-containing gas.

18. The method of Claim 15 wherein said heating step is performed at a temperature of from about 900° to about 1350°C.

19. The method of Claim 18 wherein said heating step is performed at a temperature of from about 1200° to about 1335°C.

20. The method of Claim 1 further comprising performing a selective ion implantation step after formation of the Ge-containing layer and prior to heating such that said heating step forms a patterned SiGe-on-insulator substrate material in which portions of the SiGe layer are substantially metastable and strained and other portions of the SiGe layer are substantially relaxed.

21. The method of Claim 20 wherein the selective ion implantation step includes implanting ions selected from the group consisting of hydrogen, boron, carbon, nitrogen, oxygen, silicon, phosphorous, germanium, arsenic, any of the inert gas ions, and mixtures thereof.

22. The method of Claim 21 wherein said implanted ions are hydrogen ions.

23. The method of Claim 20 wherein said selective ion implantation step is performed using an ion concentration of below 3E16 atoms/cm^2.

24. The method of Claim 20 wherein hydrogen ions are implanted during said selective ion implantation step at an energy of from about 1 to about 100 keV.

25. A substrate material comprising:

a Si-containing substrate;

an insulating region that is resistant to Ge diffusion present atop the Si-containing substrate; and

a substantially metastable SiGe layer which is resistant to relaxation present atop the insulating region.

26. The substrate material of Claim 25 wherein said insulating region is patterned.

27. The substrate material of Claim 25 wherein said insulating region is unpatterned.

28. The substrate material of Claim 25 wherein said insulating region comprises crystalline or non-crystalline oxides, or crystalline or non-crystalline nitrides.

29. The substrate material of Claim 25 wherein said insulating region is a buried oxide region that is patterned or unpatterned.

30. A substrate material comprising:

a Si-containing substrate;

an insulating region that is resistant to Ge diffusion present atop the Si-containing substrate; and

a substantially metastable SiGe region which is resistant to relaxation present atop the insulating region; and

a relaxed SiGe region abutting the substantially metastable SiGe region.